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Abstract

A total of 880 weanling pigs (initially 15.6 lb and 16 to 20 d of age) were used in a 41-d experiment to compare the effects of different antibiotic regimens on growth performance and economic return in the nursery phase. Pigs were alloted to 1 of 5 treatment groups based on weight within gender. The antibiotic regimens included: (1) control diets containing no antibiotic throughout the trial, (2) a combination of Denagard (Novartis Animal Health, Greensboro, NC) at 35g/ton and chlortetracycline at 400g/ton (Denagard/CTC) for the entire 41-d trial, (3) a Pulmotil (Elanco, Greenfield, IN) regimen of 363g/ton from d 0 to 10 followed by 181g/d from d 10 to 41, (4) Denagard 200 from d 0 to 10 followed by Denagard/CTC from d 10 to 41, and (5) Denagard/CTC from d 0 to 10, Denagard 200 from d 10 to 20, and Denagard/ CTC from d 20 to 41. From d 0 to 10, ADG, ADFI, and F/G were similar ($P > 0.40$) between the pigs fed nonmedicated diets and the mean of the groups fed diets containing antibiotics. However, from d 10 to 20, 20 to 41, and for the overall trial, pigs fed diets containing antibiotics had greater ($P < 0.05$) ADG and improved ($P < 0.04$) F/G than pigs fed the control diet without antibiotics. Pigs fed diets containing Denagard/ CTC had greater ($P < 0.02$) ADG and ADFI than pigs fed Pulmotil for d 0 to 10, 20 to 41, and the overall trial. No differences were found ($P > 0.18$) between pigs fed Denagard/CTC and Denagard 200 during any phase. Final pig weights were greater for pigs fed diets containing antibiotics compared with the control ($P < 0.01$) and for pigs fed Denagard/CTC compared with pigs fed Pulmotil ($P < 0.05$). Adding antibiotics to the diets increased ($P < 0.01$) feed cost per pig; however, income over feed cost (IOFC) also increased for pigs fed Denagard/CTC compared with the control ($P < 0.01$) and compared with pigs fed Pulmotil ($P < 0.01$). These results demonstrate that adding antibiotics to the nursery diet improved pig performance and economic return.; Swine Day, Manhattan, KS, November 18, 2010

Keywords

Swine Day, 2010; Kansas Agricultural Experiment Station contribution; no. 11-016-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 1038; Swine; Antibiotic; Denagard; Pulmotil

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A Comparison of Denagard, Denagard/CTC and Pulmotil on Nursery Pig Growth Performance and Economic Return[1]

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Summary

A total of 880 weanling pigs (initially 15.6 lb and 16 to 20 d of age) were used in a 41-d experiment to compare the effects of different antibiotic regimens on growth performance and economic return in the nursery phase. Pigs were alloted to 1 of 5 treatment groups based on weight within gender. The antibiotic regimens included: (1) control diets containing no antibiotic throughout the trial, (2) a combination of Denagard (Novartis Animal Health, Greensboro, NC) at 35g/ton and chlortetracycline at 400g/ton (Denagard/CTC) for the entire 41-d trial, (3) a Pulmotil (Elanco, Greenfield, IN) regimen of 363g/ton from d 0 to 10 followed by 181g/d from d 10 to 41, (4) Denagard 200 from d 0 to 10 followed by Denagard/CTC from d 10 to 41, and (5) Denagard/CTC from d 0 to 10, Denagard 200 from d 10 to 20, and Denagard/CTC from d 20 to 41. From d 0 to 10, ADG, ADFI, and F/G were similar ($P > 0.40$) between the pigs fed nonmedicated diets and the mean of the groups fed diets containing antibiotics. However, from d 10 to 20, 20 to 41, and for the overall trial, pigs fed diets containing antibiotics had greater ($P < 0.05$) ADG and improved ($P < 0.04$) F/G than pigs fed the control diet without antibiotics. Pigs fed diets containing Denagard/CTC had greater ($P < 0.02$) ADG and ADFI than pigs fed Pulmotil for d 0 to 10, 20 to 41, and the overall trial. No differences were found ($P > 0.18$) between pigs fed Denagard/CTC and Denagard 200 during any phase. Final pig weights were greater for pigs fed diets containing antibiotics compared with the control ($P < 0.01$) and for pigs fed Denagard/CTC compared with pigs fed Pulmotil ($P < 0.05$). Adding antibiotics to the diets increased ($P < 0.01$) feed cost per pig; however, income over feed cost (IOFC) also increased for pigs fed Denagard/CTC compared with the control ($P < 0.01$) and compared with pigs fed Pulmotil ($P < 0.01$). These results demonstrate that adding antibiotics to the nursery diet improved pig performance and economic return.

Key words: antibiotic, Denagard, Pulmotil

Introduction

In-feed antibiotics have been widely used for many years to prevent disease and increase growth rates in nursery pigs. These antibiotics have been found to increase ADG and ADFI, subsequently increasing pig weights (Steidinger et al., 2009[4]). In the Swine Day

[1] Appreciation is expressed to Novartis Animal Health, Greensboro, NC, for financial assistance for this project.

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2008 and 2009 Reports of Progress (Steidinger et al., 2008; 2009[5,6]), authors compared pigs fed different antibiotic regimens, including combinations of Denagard (Novartis Animal Health, Greensboro, NC) and chlortetracycline (Denagard/CTC) with pigs fed Mecadox (Philbro Animal Health Corp., Ridgefield Park, NJ) and oxytetracycline (Mecadox/OTC) or with pigs fed Pulmotil (Elanco Animal Health, Greenfield, IN). All of the antibiotic regimens tested improved growth performance and income over feed cost (IOFC) compared with pigs fed no antibiotic. The objective of this study was to determine the effect of several feed antibiotic regimens on growth performance and economic return in a pig flow with porcine reproductive and respiratory syndrome virus (PRRSv) circulation.

Procedures

A total of 880 weanling pigs (15.6 pounds and 16 to 20 d of age), were used in a 41-d study to determine the effect on nursery pig performance of Denagard, Denagard/CTC, and Pulmotil. Pigs used in this study originated from a PRRSv-positive herd and also tested positive for *Mycoplasma hyopneumoniae.* Serologic testing confirmed circulating PRRSv was present in the pigs during the study.

The pigs were housed in a wean-to-finish facility containing 53 pens with 22 pigs per pen (11 gilts and 11 barrows). Forty pens were used in the study with 8 replications per treatment. Each pen had slatted floors, one 5-hole feeder, and a nipple waterer. A robotic system (Feedlogic, Willmar, MN) was used to dispense and record feed. By d 14 of the trial, all pigs had seroconverted to PRRS with 100% of the samples being PCR-positive from d 14 to 42. The pigs were vaccinated for *Mycoplasma hyopneumoniae* at wks 2 and 4, and Circovirus as recommended by the veterinarian.

The pigs were all weaned on the same day (d 0) and divided into 5 treatment groups. Each of the 5 groups contained 176 pigs, for a total of 880 pigs. They were monitored daily by the farm's staff, and any critically ill or injured pigs were humanely euthanized based on Novartis Animal Health's euthanasia policies.

All treatment groups received the same 3-phase (d 0 to d 10, d 10 to d 20, and d 20 to d 41) corn-soybean meal-based diets. The only difference between diets within each phase was the antibiotic regimen. The antibiotic regimens tested included: (1) control diets containing no antibiotic throughout the trial, (2) a combination of Denagard at 35g/ton and chlortetracycline at 400g/ton (Denagard/CTC) for the entire 41-d trial, (3) Pulmotil at 363g/ton from d 0 to 10 followed by 181g/ton from d 10 to 41, (4) Denagard 200g/ton from d 0 to 10 followed by Denagard/CTC from d 10 to 41, and (5) Denagard/CTC from d 0 to 10, Denagard 200g/ton from d 10 to 20 and Denagard/CTC from d 20 to 41 (Table 1).

[5] Steidinger, M.U., M.D. Tokach, D. Dau, S.S. Dritz, J.M. DeRouchey, R.D. Goodband, and J.L. Nelssen. Comparison of different antibiotic sequences on nursery pig performance and economic return. Swine Day 2009, Report of Progress 1020, pp 122-131.

[6] Steidinger, MU., M.D. Tokach, D. Dau, S.S. Dritz, J.M. DeRouchey, R.D. Goodband, and J.L. Nelssen. Influence of antibiotic sequence in the nursery on pig performance and economic return. Swine Day 2008, Report of Progress 1001, pp. 74-81.

Throughout the study, the pigs had ad libitum access to feed and water. Feed samples were collected at the feed mill and farm from each diet each phase and analyzed to verify that the desired antibiotic levels were present (Table 2).

All pigs and feeders were weighed on d 0, 10, 20, and 41 to determine ADG, ADFI, and F/G. Pig mortality and the number of pigs treated per pen were recorded. Actual diet costs were used to calculate the feed costs associated with each treatment. Income over feed cost (IOFC) was calculated for market prices of $0.50/lb and $1.00/lb. The $0.50/lb of gain was based on the assumption that any gain in the nursery would not increase or decrease at market, and $1.00/lb of gain assumed that each lb of gain in the nursery was equivalent to 2 lb at market (Tables 3 and 4).

The MIXED procedure was used in SAS (SAS Institute, Inc., Cary, NC) to analyze the data. Single degree of freedom contrasts were used to make comparisons between the control versus all other treatments, Denagard/CTC versus Pulmotil, Denagard/CTC versus Denagard 200 in Phases 1 and 2, and Denagard 200 versus Pulmotil in Phases 1 and 2.

Results and Discussion

Throughout the study, mortality remained constant with the source's historical averages. No adverse reactions to the antibiotic additions were observed, and their inclusion in the diets was confirmed using laboratory analysis. The analyzed levels of the antibiotics were all slightly lower than the expected values, ranging from 66% to 91% of the expected values. The presence of trace levels of Denagard (Phase 1 and 2), Chlortetracycline (Phase 1, 2, and 3), and Pulmotil (Phases 1, 2, and 3) in the control diet samples was most likely due to contamination at the time of sampling. Contamination at the time of the diet blending was not considered likely due to the control diets being mixed before the treatment diets (Table 2).

Adding antibiotics to the diet did not improve ($P > 0.40$) pig performance from d 0 to 10 (Table 3); however, pigs fed diets containing antibiotics had greater ($P < 0.05$) ADG for d 10 to 21, 21 to 42, and for the overall trial (d 0 to 42). Pigs fed diets with antibiotics also had greater ($P < 0.01$) ADFI and improved ($P < 0.01$) F/G from d 20 to 41 and for the overall trial and tended to have improved ($P<0.10$) ADFI and F/G from d 10 to 20. When comparing the response of pigs fed the control diet to those fed Pulmotil or Denagard/CTC, pigs fed Denagard/CTC had improved ($P< 0.01$) ADG, ADFI, and F/G compared with the control, but those fed Pulmotil only had improved F/G ($P <0.01$), with no effect ($P> 0.05$) on ADG or ADFI. Pigs fed diets containing antibiotics were 2.5 to 4.5 lb heavier ($P < 0.01$) at the end of the trial than pigs fed the control diet without antibiotics. Adding antibiotics to the diet increased ($P < 0.01$) feed cost per pig and feed cost per pound of gain, but also increased ($P < 0.01$) profitability as measured by IOFC (Table 4). These data clearly show the improvement in growth performance that can be achieved when health-challenged pigs are fed diets containing antibiotics.

When comparing pigs fed Denagard/CTC with those fed Pulmotil, pigs fed Denagard/CTC had increased ($P < 0.02$) ADG and ADFI from d 0 to 10, 20 to 41, and 0 to 41. The increased growth rate resulted in pigs fed Denagard/CTC through the trial being 2.5 lb heavier ($P < 0.05$) than pigs fed Pulmotil at the end of the trial. There were no

differences ($P > 0.31$) in F/G between pigs fed diets containing Denagard/CTC and pigs fed diets containing Pulmotil during any stage. Because of higher ADFI, pigs fed the diet containing Denagard/CTC had higher ($P < 0.05$) feed cost per pig than pigs fed diets containing Pulmotil. However, pigs fed diets containing Denagard/CTC had lower ($P < 0.01$) feed costs per pound of gain and improved ($P < 0.01$) IOFC from d 10 to 20 and d 20 to 41 whether gain was valued at $0.50/lb or $1.00/lb. These results are similar to the results published in the 2009 Swine Day Report comparing performance of pigs fed Denagard/CTC to pigs fed Pulmotil.

Denagard/CTC and Denagard 200 were also compared to determine the effectiveness of Denagard as an individual antibiotic. Both antibiotic options performed similarly, with no differences in ADG ($P > 0.49$), ADFI ($P > 0.55$), or F/G ($P > 0.20$). Feed costs per pig were similar between pigs fed diets containing Denagard/CTC and Denagard 200, except pigs fed the diets containing Denagard/CTC had lower ($P < 0.01$) feed cost from d 10 to 20. Feed cost per pound of gain was lower ($P < 0.05$) for pigs fed Denagard/CTC from d 0 to 10, d 10 to 20, and overall than pigs fed Denagard 200. Pigs fed diets containing Denagard/CTC had greater ($P < 0.05$) IOFC than pigs fed Denagard 200, whether gain was valued at $0.50/lb or $1.00/lb.

While the number of individual antibiotic treatments per pen was not significantly different between Denagard/CTC versus Pulmotil ($P = 0.98$) or Denagard 200 ($P = 0.99$), pigs fed diets containing Denagard/CTC in the diet at any point during the trial required fewer individual antibiotic treatments ($P < 0.02$) than pigs fed the control diets without antibiotics (Table 2).

The overall data from this experiment are consistent with the Swine Day publications from 2008 and 2009, showing improvement in weight gain and income over feed cost for pigs fed Denagard/CTC (Steidinger et al, 2008; Steidinger et al, 2009). These results confirm the results of our first two experiments that adding antibiotics to the nursery diet improved pig performance and economic return of health-challenged pigs.

Table 1. Dietary antibiotics in each phase

Treatment	d 0 to d 10	d 10 to d 20	d 20 to d 41
1	No medication	No medication	No medication
2	Denagard/CTC[1]	Denagard/CTC[1]	Denagard/CTC[1]
3	Pulmotil, 363 g/ton	Pulmotil, 181 g/ton	Pulmotil, 181 g/ton
4	Denagard, 200 g/ton	Denagard/CTC[1]	Denagard/CTC[1]
5	Denagard/CTC[1]	Denagard, 200 g/ton	Denagard/CTC[1]

[1]Denagard at 35 g/ton and chlortetracycline at 400 g/ton.

Table 2. Analyzed in-feed antibiotic levels

	Antibiotic level, g/ton								
	Denagard			Chlortetracycline			Pulmotil		
Diet	Expected	Analyzed	% of Expected	Expected	Analyzed	% of Expected	Expected	Analyzed	% of Expected
Phase 1									
Control	0	7.3		0	18.6		0	<45.4	
Denagard/CTC[1,2]	35	29.1	83.1	400	353	88.3	---	---	---
Pulmotil[2]	---	---	---	---	---	---	363	328	90.4
Denagard 200	200	175	87.5	---	---	---	---	---	---
Phase 2									
Control	0	3.6	---	0	11.3	---	0	<45.4	---
Denagard/CTC[1,2]	35	31.5	90.0	400	343	85.8	---	---	---
Pulmotil[2]	---	---	---	---	---	---	---	---	---
Denagard 200	200	156.7	78.4	---	---	---	---	---	---
Phase 3									
Control	0	0	---	0	3.57	---	0	<45.4	---
Denagard/CTC[1,2]	35	31.6	90.3	400	312	78.0	---	---	---
Pulmotil[2]	---	---	---	---	---	---	181	121	66.9

[1] Denagard (tiamulin) analysis conducted at CIA Laboratories, St. Joseph, MO.
[2] Chlortetracycline and Pulmotil analysis conducted at Eurofins – AvTech Laboratories, Portage, MI.

Table 3. Influence of antibiotic additions to the diet on pig performance[1]

	Treatments[2]						Contrasts				
	1	2	3	4	5						
d 0 to 10:	No med	Den/CTC	Pulmotil	Den 200	Den/CTC						
d 10 to 20:	No med	Den/CTC	Pulmotil	Den/CTC	Den 200						
d 20 to 41:	No med	Den/CTC	Pulmotil	Den/CTC	Den/CTC	SED	No med vs all others	No med vs Pulmotil	No med vs Den/CTC	Den/CTC vs Pulmotil	Den/CTC vs Den 200[3]	Den 200 vs Pulmotil[4]
d 0 to 10												
ADG, lb	0.39	0.39	0.34	0.38	0.41	0.03	0.85	0.13	0.55	0.02	0.49	0.15
ADFI, lb	0.45	0.46	0.42	0.46	0.48	0.02	0.86	0.20	0.37	0.02	0.55	0.12
F/G	1.16	1.20	1.24	1.19	1.17	0.06	0.40	0.20	0.63	0.31	0.88	0.45
d 10 to 20												
ADG, lb	0.69	0.81	0.73	0.81	0.78	0.06	0.05	0.44	0.02	0.14	0.50	0.02
ADFI, lb	0.90	0.96	0.91	1.01	1.00	0.05	0.10	0.85	0.06	0.10	0.85	0.02
F/G	1.32	1.19	1.25	1.27	1.28	0.05	0.08	0.16	0.04	0.66	0.18	0.24
d 20 to 41												
ADG, lb	0.89	1.05	0.95	1.05	1.06	0.04	0.01	0.15	0.01	0.01	0.74	0.01
ADFI, lb	1.55	1.68	1.51	1.72	1.73	0.04	0.01	0.36	0.01	0.01	0.63	0.01
F/G	1.74	1.61	1.60	1.66	1.63	0.05	0.01	0.01	0.01	0.42	0.33	0.28
d 0 to 41												
ADG, lb	0.72	0.83	0.74	0.83	0.83	0.03	0.01	0.36	0.01	0.01	0.87	0.01
ADFI, lb	1.11	1.20	1.09	1.24	1.24	0.04	0.01	0.49	0.01	0.01	0.55	0.01
F/G	1.56	1.46	1.47	1.50	1.49	0.03	0.01	0.01	0.01	0.45	0.20	0.19
Weight, lb												
d 0	15.6	15.6	15.6	15.6	15.6	0.41	1.00	1.00	1.00	0.99	0.99	1.00
d 10	19.4	19.4	19.0	19.4	19.7	0.58	0.93	0.45	0.76	0.24	0.60	0.23
d 20	26.7	27.8	26.4	27.7	27.9	0.99	0.33	0.80	0.22	0.13	0.82	0.01
d 41	45.9	49.8	47.4	49.6	50.5	1.27	0.01	0.23	0.01	0.05	0.47	0.02
Survival, %	94.9%	98.3%	93.8%	98.9%	95.5%	--	0.20	0.20	0.11	0.14	0.70	0.15
Treatments/pen[5]	3.5	1.3	2.8	1.3	1.3	--	.06	.67	0.08	.18	.99	.17

[1] Each mean represents 8 pens with 22 pigs per pen for a total of 880 pigs.

[2] Den/CTC was a combination of Denagard at 35 g/ton and chlortetracycline at 400 g/ton. Pulmotil was 363 g/ton from d 0 to 10 and 181 g/ton from d 10 to 41. Den 200 was Denagard at 200 g/ton.

[3] Pigs fed Denagard 200 in either Phase 1 or 2 were compared to pigs receiving only Den/CTC: Phase 1 (Treatment 2 vs 4), Phase 2 (Treatment 2 vs 5), Phase 3 and overall (Treatment 2 vs 4 & 5).

[4] Pigs fed Denagard 200 in either Phase 1 or 2 were compared to pigs receiving only Pulmotil: Phase 1 (Treatment 3 vs 4), Phase 2 (Treatment 3 vs 5), Phase 3 and overall (Treatment 3 vs 4 & 5).

[5] Treatments per pen is the mean number of individual antibiotic treatments per pen. No medication vs the mean of the three treatments with Denagard had a p-value of 0.02.

Table 4. Influence of antibiotic additions to the diet on feed economics[1]

	Treatments[2]						Contrasts				
	1	2	3	4	5						
d 0 to 10:	No med	Den/CTC	Pulmotil	Den 200	Den/CTC						
d 10 to 20:	No med	Den/CTC	Pulmotil	Den/CTC	Den 200						
d 20 to 41:	No med	Den/CTC	Pulmotil	Den/CTC	Den/CTC	SED	No med vs all others	No med vs Pulmotil	No med vs Den/CTC	Den/CTC vs Pulmotil	Den/CTC vs Den 200[3]	Den 200 vs Pulmotil[4]
Feed cost, $/pig												
d 0 to d 10	1.62	1.72	1.70	1.85	1.79	0.09	0.05	0.35	0.09	0.52	0.25	0.12
d 10 to d 20	2.13	2.40	2.36	2.53	2.79	0.137	0.01	0.11	0.01	0.38	0.01	0.38
d 20 to d 41	3.48	4.23	4.10	4.33	4.35	0.106	0.01	0.01	0.01	0.03	0.63	0.45
d 0 to d 41	7.23	8.34	8.16	8.71	8.93	0.277	0.01	0.01	0.01	0.03	0.10	0.22
Feed cost, $/lb gain												
d 0 to d 10	0.42	0.45	0.50	0.48	0.44	0.022	0.01	0.01	0.21	0.01	0.05	0.01
d 10 to d 20	0.31	0.30	0.32	0.32	0.36	0.012	0.20	0.34	0.63	0.12	0.01	0.01
d 20 to d 41	0.19	0.19	0.21	0.20	0.20	0.006	0.01	0.01	0.05	0.01	0.34	0.23
d 0 to d 41	0.25	0.25	0.27	0.26	0.26	0.01	0.01	0.01	0.04	0.01	0.01	0.99
Income over feed cost[5], $/pig												
d 0 to d 10	0.31	0.23	0.00	0.07	0.27	0.094	0.03	0.01	0.46	0.01	0.03	0.01
d 10 to d 20	1.31	1.66	1.32	1.54	1.10	0.181	0.53	0.97	0.08	0.08	0.01	0.04
d 20 to d 41	5.91	6.76	5.83	6.63	6.80	0.324	0.02	0.82	0.01	0.01	0.58	0.01
d 0 to d 41	7.48	8.59	7.03	8.18	8.06	0.318	0.06	0.17	0.01	0.01	0.24	0.01
Income over feed cost[6], $/pig												
d 0 to d 10	2.24	2.18	1.71	1.99	2.34	0.227	0.30	0.02	0.94	0.01	0.18	0.01
d 10 to d 20	4.76	5.72	5.00	5.61	4.99	0.47	0.13	0.62	0.03	0.11	0.10	0.04
d 20 to d 41	15.29	17.75	15.77	17.58	17.96	0.70	0.01	0.50	0.01	0.01	0.66	0.01
d 0 to d 41	22.19	25.53	22.23	25.07	25.05	0.823	0.01	0.96	0.01	0.01	0.72	0.01

[1] Each mean represents 8 pens with 22 pigs per pen for a total of 880 pigs.
[2] Den/CTC was a combination of Denagard at 35 g/ton and chlortetracycline at 400 g/ton. Pulmotil was 363 g/ton from d 0 to 10 and 181 g/ton from d 10 to 41. Den 200 was Denagard at 200 g/ton.
[3] Pigs fed Denagard 200 in either Phase 1 or 2 were compared to pigs receiving only Den/CTC: Phase 1 (Treatment 2 vs 4), Phase 2 (Treatment 2 vs 5), Phase 3 and overall (Treatment 2 vs 4 & 5).
[4] Pigs fed Denagard 200 in either Phase 1 or 2 were compared to pigs receiving only Pulmotil: Phase 1 (Treatment 3 vs 4), Phase 2 (Treatment 3 vs 5), Phase 3 and overall (Treatment 3 vs 4 & 5).
[5] Income over feed cost used $0.50/lb for the value of gain.
[6] Income over feed cost used $1.00/lb for the value of gain.